AlphaServer GS160/320

CPU Online Addition and Removal

Order Number: EK-GSHPG-RM. B01

This document is for system owners and service providers of *AlphaServer* 160/320 systems. It describes how to add and replace CPU modules in a running system and restrictions related to that servicing.

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Chapter 1
Overview

The *AlphaServer* GS160/320 systems support the removal and addition of CPU modules while the system is powered on and applications are running. This chapter provides background information so that one can safely service these machines and understand requirements about which CPUs can go where. Chapter 2 outlines the procedures and gives specific operating system examples of replacing a CPU in a running system.

Questions and Answers

What is the advantage of online service?

These systems were designed to provide high availability, so that the operating systems can continue to run while parts of the machine can be serviced or upgraded. Some components can be replaced while the operating system continues to run and power is present in the area where the component is to be replaced. In other cases power is removed from the area that is to be serviced, but other parts of the system remain powered on.

The online addition and removal of CPU modules means that a faulty CPU module can be replaced while the operating system and applications continue to run. In addition, the CPU capacity can be expanded without any downtime.

What is required for online service of CPUs?

The system must be running versions of firmware, operating systems, and WEBES that support this function. See Table 1–1. Also, with *Tru64 UNIX* Compaq Analyze must be running in auto analysis mode to support indictment of faulty CPUs (Compaq Analyze is one of the WEBES (Web-Based Enterprise Services) tools). *OpenVMS* does not yet support indictment of faulty CPUs but will in a future release.

Table 1–1 Minimum Versions Required

CPU	Tru64 UNIX	OpenVMS	SCM & SRM	WEBES
B4166	V5.1A	V7.3*	V6.0	V4.0
B4168	V5.1A	V7.3-1	V6.3	V4.0

*Remove and replace only.

Who may service these systems?

Only those with appropriate technical training and experience should attempt to service these systems.

What precautions are to be taken?

Table 1–2 lists the various power and mechanical hazards in the system. Because these systems use a great deal of power, caution must be exercised when servicing them. Remove all jewelry when working on the systems. The use of ESD straps is required. Wrist straps are located on the front and rear doors of system cabinet 1 and on the rear door of the power cabinet.

Table 1–2 Hazards and Safety Features

Hazard	Risks	Safety Features	Exposed Areas
AC power	Flashing metal Shock Death	AC only in the power cabinet AC loads fully enclosed Securely mated wiring system	None
48 VDC power	Flashing metal Welding of jewelry ➡ heat	Securely mated wiring system 48V isolated from cabinets Covers Current limit	QBB backplane H-switch backplane CPU module Power modules
Low voltage power	Flashing metal Welding of jewelry ➡ heat	Short circuit protection Current limit	QBB backplane H-switch backplane Logic modules Power modules
System blowers	Severe cuts Loss of fingers	Grill	Exposed only when lower system box out
PCI enclosure	Low voltage power hazard Battery on standard I/O	AC loads fully enclosed Interlock	Under power supply connector on the backplane

What do I need to know about the system clock, CPU variants, and the system box QBBs?

Each CPU variant supports a different cache size. To use the larger cache size the CPU needs the QBB that supports the larger cache size, even though the faster CPUs can be installed in earlier QBBs.

Furthermore, the CPU derives its operating clock speed from the system clock, so you need to know the setting of the system clock. Most of these components can coexist in the same system. But for optimum performance the faster CPUs should be in a system with the 9.0 ns clock setting.

Table 1–3 compares the B4125, B4166, and B4168 CPUs, and Table 1–4 compares the system boxes.

Table 1–3 Comparison of CPUs

CPU Part Number	B-cache Size	Speed in MHz	Comments
B4125	4 Mbytes	731	The B4125 must operate at this speed and requires the system clock to run at 9.6 ns.
B4166	4 or 8 Mbytes	1001	The B4166 runs at this speed and uses all its available B-cache when all CPUs in the system are B4166 or it is in a system with B4168 CPUs, the clock runs at 9.0 ns, and the CPUs are in a system box with duplicate tag support of the 8-MB cache. If the system box duplicate tag supports only 4-MB cache, then only 4 of the 8 Mbytes of B-cache on the CPU are used.
	4 or 8 Mbytes	940	The B4166 runs at this speed and uses all its available B-cache when all CPUs in the QBB are B4166 or it is mixed with B4168 CPUs, but the system clock runs at 9.6 ns. If the system box duplicate tag supports only 4-MB cache, then only 4 of the 8 Mbytes of B-cache on the CPU are used.
	Uses 4 of its 8 Mbyte B-cache	731	The B4166 runs at this speed and uses 4 Mbytes of its B-cache when it is in a QBB with a B4125 CPU and the clock runs at 9.6 ns.

Continued on next page

Table 1–3 Comparison of CPUs (Continued)

CPU Part Number	B-cache Size	Speed in MHz	Comments
B4168	8 or 16 Mbytes	1224	The B4168 runs at this speed and uses all its available B-cache when all CPUs in the system are B4168 or B4166, the clock runs at 9.0 ns, and the CPUs are in a system box with duplicate tag support of the 16-MB cache. If the system box duplicate tag supports an 8-MB cache, then 8 of the 16 Mbytes of B-cache on the CPU are used.
	Uses 4 of its 16 MB B-cache	1148	The B4168 runs at this speed when placed in a QBB that supports only 4 Mbytes of B-cache, when all CPUs in the system are B4168 or B4166, and the clock runs at 9.0 ns.
	Uses 8 of its 16 MB B-cache	1001	The B4168 runs at this speed and uses 8 Mbytes of its B-cache when the B4168 is placed in the same QBB as the B4166 and the clock is at 9.0 ns.
	4 or 8 Mbytes	940	The B4168 runs at this speed when all CPUs in the QBB are B4168 or B4166, and the system clock runs at 9.6 ns. If the system box duplicate tag supports only 4-MB or 8-MB cache, then only 4 or 8 of the 16 Mbytes of B-cache on the CPU are used.
	Uses 4 of its 16 MB B-cache	731	The B4168 runs at this speed and uses 4 Mbytes of its B-cache when the B4168 is placed in the same QBB as the B4125 and the clock is at 9.6 ns.

Table 1–4 Comparison of System Boxes

System Box Part Number	Cache Size Supported by the Box	Comments
BA51A-AA (54-25043-01/02)	4 Mbytes	Though the B4166 and B4168 CPUs have larger B-caches, only 4 Mbytes are used when placed in this backplane.
BA51A-BA (54-25045-01/02)	4 or 8 Mbytes	When CPUs in this backplane are B4166 or B4168, they use 8 Mbytes of B-cache. If a B4125 is mixed with other speed CPUs on the same backplane, all are configured for the 4-Mbyte B-cache size.
BA51A-DA (54-30606-01/02)	4, 8, or 16 Mbytes	When all CPUs in this backplane are B4168, they use 16 Mbytes of B-cache. If CPUs are mixed, B4125, B4166, or B4168 on the same backplane, all are configured for the B-cache size of the processor that supports the smallest size (4 or 8 Mbytes).

In summary:

- All variants of system boxes can coexist in a system.
- The B4125 CPUs run at 731 MHz and require a 9.6 ns system clock. B4125 CPUs are not supported with the 9.0 ns system clock.
- The B4166 and B4168 CPUs can operate at different speeds and use different amounts of their B-cache depending upon the system box, the system clock speed, and whether the CPU is configured with the B4125 CPU.
- The B4166 CPU requires that the SRM console firmware be at V6.0 or higher and that the microprocessor firmware be at V6.0 or higher.
- The B4168 CPU requires that the SRM console firmware be at V6.3 or higher and that the microprocessor firmware be at V6.3 or higher.

Are there additional restrictions when adding or changing CPUs when the operating system is running?

Yes, because the firmware recorded what speed modules were in which slots at system startup, you should not change the speed of the CPU in that slot. The firmware will not take note of the change in the CPU until the next *power cycle*.*

> ***Terminology clarification:***
> ***Power cycle**: Occurs when the SRM or SCM **power off** console command is issued, followed by the SRM **power on** command. Power is turned off and on, testing begins, and the SRM prompt returns.*
> ***Initialize:** Occurs when the SRM **initialize** command is issued; it causes the I/O adapters to initialize. The system must then be booted.*
> ***Reboot:** Occurs at the operating system level; causes an SRM **initialize** command.*
> ***Reset:** Occurs when the control panel Reset button is pushed or when the SRM or SCM **reset** command is issued. This causes a system-level hardware reset, initiating testing and return of the SRM prompt. Power is not turned off.*

Note these additional restrictions:

- All CPUs in a QBB will run at the same speed; all QBBs in a GS system operate from one common reference clock.
- *OpenVMS* does not support mixing CPUs in an instance of its operating system (a partition) with a speed difference of greater than 250 MHz.

Can I remove/replace the primary CPU?

No. In a partitioned system, this restriction applies to each primary CPU in each partition.

How does a service person determine the system environment so he can proceed with CPU online service?

Some information must be obtained from the SRM console and the SCM monitor, so a hard-copy record should be stored with the system. It would be helpful to have printouts of the SCM **show fru** and SRM **show config** commands. From these displays one can determine the following:

- System clock speed setting
  9.0 or 9.6 ns
- QBB part numbers, which indicate the size of B-cache supported
  54-25043-01/02 – 4 Mbytes

54-25045-01/02 – 4 or 8 Mbytes
54-30630-01/02 – 4, 8, or16 Mbytes

SCM Example

```
SCM_E0> show fru
FRUname          E  Part#              Serial#    Model/Other Alias/Misc
       [part of display omitted]
QBB0             80 54-25045-01.C01 ❶ SM01300025 ..........
QBB0.PSM         00 54-25074-01.L01    NI94770176
QBB0.PWR         00 54-25017-01.F01    NI93970911
QBB0.AUX         00 54-25123-01.E01    NI94171051 ..........
QBB0.CPU0        00 B4166-AA.A03    ❷  SW01040057
QBB0.CPU1        00 B4166-AA.A03       SW04300330
QBB0.CPU2        00 B4166-AA.A03       SW01040058
QBB0.CPU3        00 B4166-AA.A03       SW05100041
```

❶ 54-25045-01.C01 is the part number for the QBB that supports a maximum of 8 Mbytes cache.

❷ All CPUs in QBB0 are B4166 CPUs.

SRM Example

```
P00>>> show config
QBB 0          Hard QBB 0
 Quad Switch                                 QSA rev 4, QSD revs 0/0/0/0
 Duplicate Tag             Up To 4 MB Caches DTag revs 1/1/1/1
 Processor 0   CPU 0       4 MB Cache        EV67 pass 2.4, 731 MHz    ❶
 Processor 1   CPU 1       4 MB Cache        EV67 pass 2.4, 731 MHz
 Processor 2   CPU 2       4 MB Cache        EV67 pass 2.4, 731 MHz
 Processor 3   CPU 3       4 MB Cache        EV67 pass 2.4, 731 MHz
```

❶ All CPUs in QBB0 are running at 731 MHz. From this we can infer that the system clock speed is set at 9.6 ns, since the B4125 731 MHz CPUs require the 9.6 ns system clock speed. If the display shows a CPU running at 1001 or 1224 MHz, then we know the system clock speed is 9.0. If you see a CPU running at 940 or 1148 MHz, then you can infer that the system clock speed is 9.6.

OpenVMS Example

```
$ show cpu

WFSI27, a Compaq AlphaServer GS160 6/940  ❶
```

❶ The CPU is identified as 6/940. From this you can infer that the system clock speed is set at 9.6, since the CPU is not running at full speed (1001 or 1224 MHz).

What is the limit on the number of cycles a CPU module can be power cycled?

CPU modules must not be power cycled (defined as a power-on and a power-off sequence) more than 1,000 cycles. This capability is intended to be exercised as needed, not by test procedures.

For More Information

Title	Part Number/Web Site
AlphaServer GS80/160/320 Service Manual	EK-GS320-SV
AlphaServer GS160/320 Upgrade Manual	EK-GS320-UP
Tru64 UNIX: Managing Online Addition and Removal	AA-RPUFA-TE
http://www.tru64unix.compaq.com/faqs/publications/pub_page/pubs_page.html	
OpenVMS Version 7.3 New Features Manual	AA-QSBFD-TE
http://www.openvms.compaq.com:8000/index.html#ovmsdocset	

Chapter 2
Examples

Online addition and replacement of CPUs is used to expand capacity, upgrade components, and replace failed components, while the operating system continues to run.

Following are the steps required to replace a CPU. Step 3 is the physical replacement of the CPU; the other steps are performed at the operating system level.

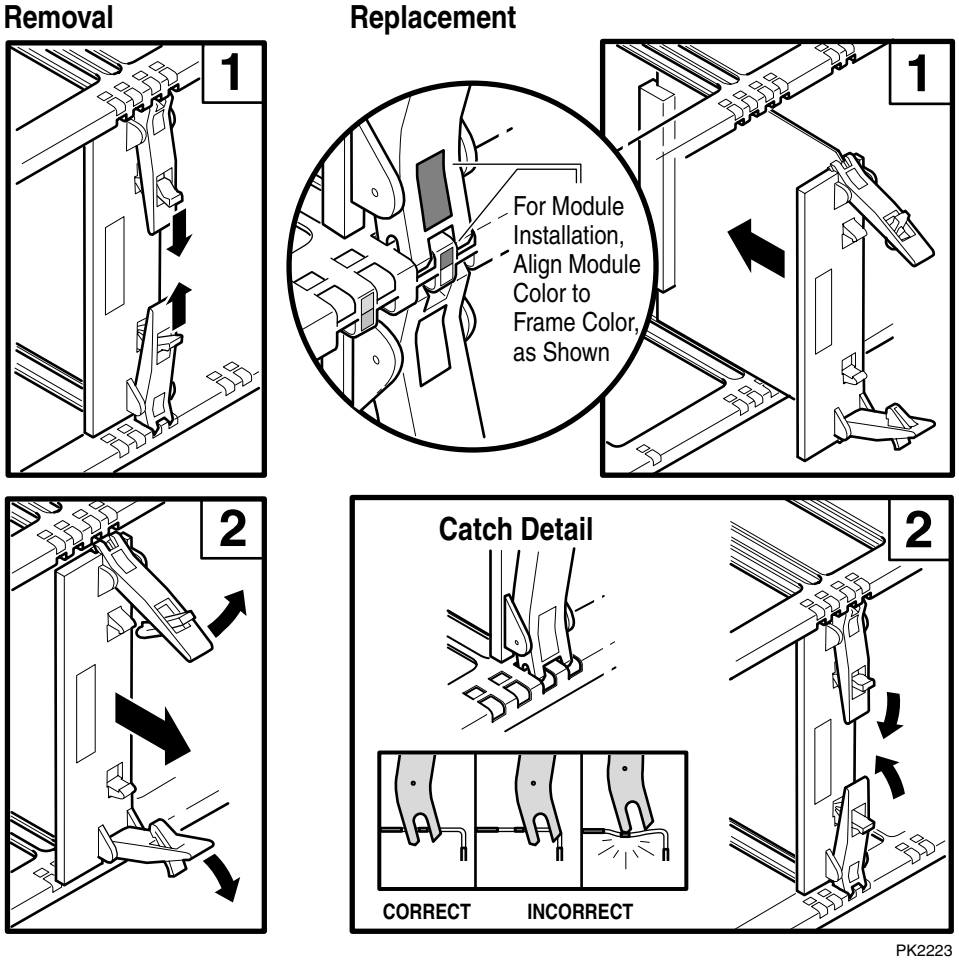
1. Take the CPU offline.
2. Remove power from the CPU. When power is removed, the yellow LED on the CPU module lights indicating that the CPU module may be safely removed.
3. Physically remove the CPU and insert another CPU module.
4. Restore power to the CPU. Self-test begins and lasts 7–10 seconds. The yellow LED on the CPU goes out and the green LED lights.
5. Put the CPU online so that the operating system can use it.

Section 2.1 shows how to handle the CPU modules. Examples of the procedure for each operating system are given in the following sections.

2.1 CPU Module Handling

Review the information on handling the CPU module before beginning the service procedure.

Figure 2–1 CPU Removal and Replacement



CAUTION: *Always wear an antistatic wrist strap when working on the system.*

See Figure 2–1. Using both hands, one on each module lever, place your index finger on the catch and thumb on the edge of the lever just below/above the arrow. First squeeze to release the lever and then pull both levers away from the module to release it from the QBB backplane.

Remove the module. Insert the replacement module and then press the levers down.

CAUTION: *Module should be moved deliberately –without any extra movement back and forth in the slot –to avoid the discharge of energy. To avoid causing a system error, close the levers only when the module is properly seated. Wait 10 seconds before moving the module again.*

2.2 Tru64 UNIX Procedure

For more information, refer to the *Tru64 UNIX* manual *Managing Online Addition and Removal.*

Example 2–1 Replacing a CPU Module

```
# /sbin/hwmgr –offline –name CPU2          ❶
hwmgr: CPU2 is now offline
# /sbin/hwmgr –power off –name CPU2        ❷
hwmgr: CPU2 is now powered off
# /sbin/hwmgr -status component –ngood     ❸

                  STATUS    ACCESS                INDICT
HWID:  HOSTNAME   SUMMARY   STATE       STATE     LEVEL     NAME
-------------------------------------------------------------------
 4:    wild-one   critical  offline     off                 CPU2

         [Remove the CPU; insert another CPU]   ❹

# /sbin/hwmgr –power on –name CPU2         ❺
hwmgr: CPU2 is now powered on

# /sbin/hwmgr –online –name CPU2           ❻
hwmgr: CPU2 is now online

# /sbin/hwmgr -status component -id 4      ❼

                   STATUS   ACCESS                 INDICT
 HWID:  HOSTNAME   SUMMARY  STATE     STATE        LEVEL   NAME
-------------------------------------------------------------------
    4:  wild-one            online    available            CPU2
```

See Table 1-1 for the minimum versions of the operating system, firmware, and WEBES needed to support online service. Also be sure to understand the distinctions and restrictions in Chapter 1 relating to the CPU models and the system boxes. Refer to Section 2.1 for instructions on removing CPU modules from the system box.

Example 2-1 shows the *Tru64 UNIX* commands that can be used in the online removal and replacement of a CPU module.

❶ Take the CPU offline. All bound processes must first be removed from the CPU to be serviced.

❷ Remove power from the CPU. The yellow LED on the module lights.

❸ Check the status of CPU 2.

❹ Take the module out of the system box and insert another one.

❺ Restore power to the CPU. The yellow LED on the CPU goes out and the green LED lights.

❻ Put the CPU online.

❼ Check the status of CPU 2.

2.3 OpenVMS Procedure

For more information, refer to *OpenVMS Version 7.3 New Features Manual.*

Example 2–2 Replacing a CPU Module

```
$ STOP/CPU 3                    ❶
%SYSTEM-I-CPUSTOPPING, trying to stop CPU 3 after it reaches quiescent state

$ SET CPU/POWER=OFF 3           ❷
%SYSTEM-I-CPUSELECTED, a selected CPU is attempting the requested transition

$ SHO CPU                       ❸
WFSI27, a Compaq AlphaServer GS160 6/1001
Multiprocessing is ENABLED. Streamlined synchronization image loaded.

Primary CPU = 000
CPU sets:
   Active               0-2,4-7
   Configure            0-7
   Powered Down         3
   Potential            0-2,4-15
   Autostart            0-31
   Failover             None
$
        [Remove the CPU; insert another CPU]      ❹

CPU3 removed from QBB0
CPU3 added to QBB0

$ SET CPU/POWER=ON 3            ❺
%SYSTEM-I-CPUSELECTED, a selected CPU is attempting the requested transition
$
QBB0 now Testing Step-0...........
~I~ QBB0/PSM30 SysEvent: CPU_SYNC_INIT              Reg0:768F Reg1:3FFF

~I~ QBB0/PSM30 SysEvent: CPU_PINIT_DONE             Reg0:768F Reg1:3FFF
```

```
$ SHOW CPU  ❻

WFSI27, a Compaq AlphaServer GS160 6/1001
Multiprocessing is ENABLED. Streamlined synchronization image loaded.

Primary CPU = 000
CPU sets:
   Active               0-7
   Configure            0-7
   Powered Down         None
   Potential            0-15
   Autostart            0-31
   Failover             None
$
```

See Table 1-1 for the minimum versions of the operating system, firmware, and WEBES needed to support online service. Also be sure to understand the distinctions and restrictions in Chapter 1 relating to the CPU models and the system boxes. Refer to Section 2.1 for instructions on removing CPU modules from the system box.

Example 2-2 shows the *OpenVMS* commands used in the online removal and replacement of a CPU module.

❶ Take the CPU offline.

❷ Remove power from the CPU. The yellow LED on the module lights.

❸ Check the status of CPU 3.

❹ Take the module out of the system box and insert another one.

❺ Restore power to the CPU, which starts the CPU. The yellow LED on the CPU goes out and the green LED lights.

❻ Check the status of CPU 3.

OpenVMS automatically adds the CPU to the active set of processors.